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APOLLO MONTHLY PROGRESS REPORT (U)

NAS9-150

October 1, 1964

Paragraph 8.1, Exhibit I

Report Period
August 16 to September 15, 1964

CLASSIFICATION CHANGE
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SPACE and INFORMATION SYSTEMS DIVISION

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CONTENTS

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ILLUSTRATIONS

TABLES

CONFIDENTIAL

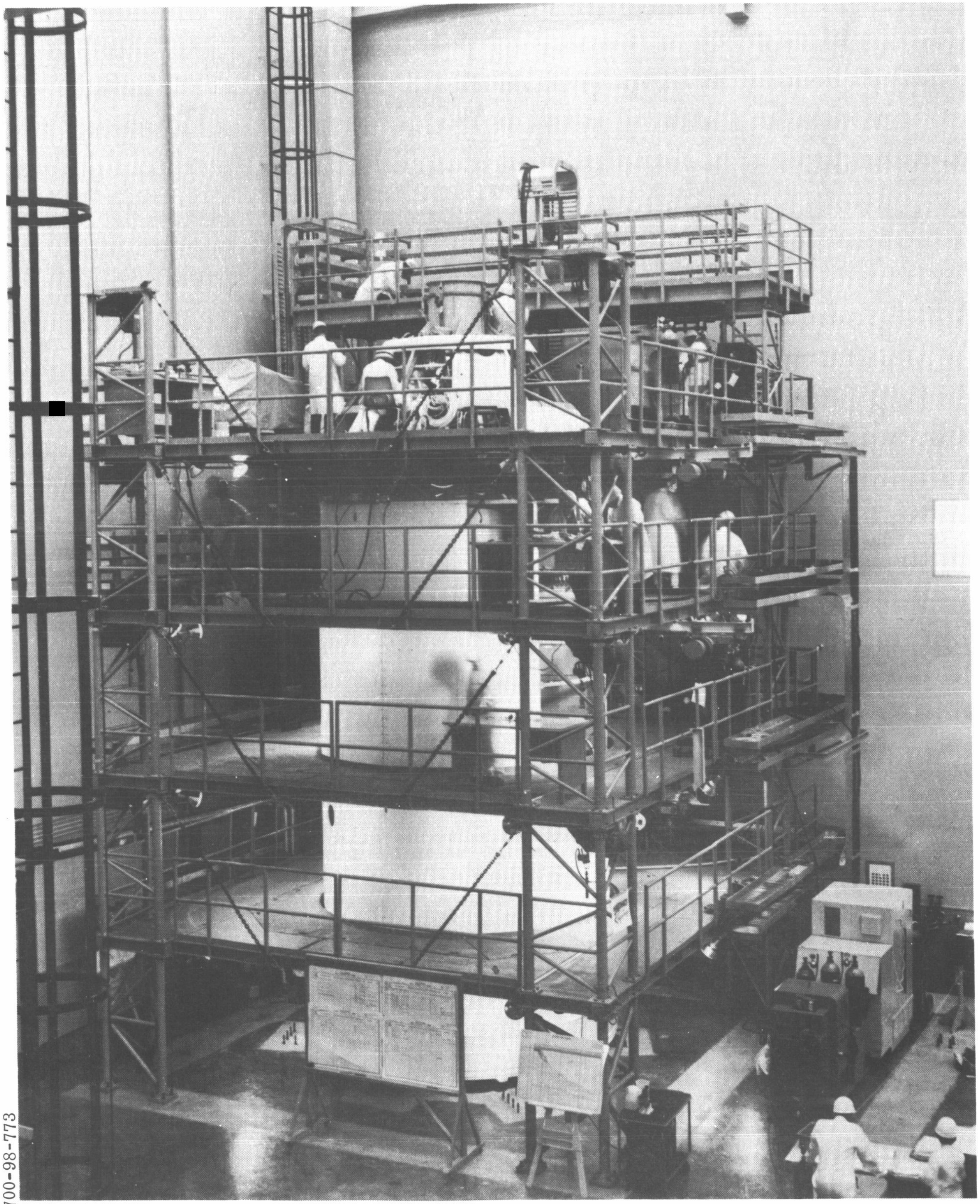

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Figure 1. Command and Service Modules, Boilerplate 14, in Work Stand, Building 290

PROGRAM MANAGEMENT

STATUS SUMMARY

The launch escape subsystems for boilerplates 16 and 26 were shipped to Kennedy Space Center (KSC) during the report period. Assembly operations for boilerplate 28 were completed, and the vehicle was transferred to the engineering development laboratory.

Boilerplate 14 (house spacecraft 1) was transferred from manufacturing to Apollo test and operations during the report period, and checkout of the electrical power and environmental control subsystems was begun. During the next report period, the checkout will be completed, and communications, instrumentation, stabilization and control, and reaction control subsystems will be installed. (See Figure 1.)

The integrated systems test of boilerplate 23 was completed during the report period, and the service module was shipped to WSMR. The command module and launch escape tower will be shipped during the next report period.

The modified parachute test vehicle, boilerplate 6A, was completed and delivered to Northrop-Ventura on September 14.

The Los Angeles Division of NAA completed the manufacture of the launch escape tower for boilerplate 22.

NASA-S&ID FEASIBILITY STUDY

During the report period, a feasibility review was conducted between NASA and S&ID to define the tasks to be performed during fiscal year 1965. Following the review, a summary was conducted for both NASA and S&ID program managers. The study resulted in agreement on tasks to be performed, deleted, or modified and clarification of the scope of the program.

CONTRACT NAS9-150

Supplemental Agreements

A supplemental agreement covering recent negotiations for master development schedule 7 has been executed by NASA and S&ID and returned to S&ID for distribution.

[redacted]

A supplemental agreement updating the NASA PERT and companion cost system and delineating report schedules, has been executed by NASA and S&ID and returned to S&ID for distribution.

Changes in Documentation Requirements, Exhibit I

The supplemental agreement deleting 13 Exhibit I reporting requirements and modifying several others has been executed. In addition, technical direction was received from NASA deleting the S&ID responsibility for the publication of flight test reports. These reports are to be coordinated by both NASA and S&ID.

ASSOCIATE CONTRACTOR ADMINISTRATION

During the report period, interface testing between the S&ID uplink and downlink equipment and the General Electric acceptance checkout equipment (ACE-SC) station was completed successfully using S&ID breadboard equipment.

TEST SITE ACTIVATION

The contract for the complete fluid system installation at Downey was awarded on September 1. System installation is to be completed by November 30.

Approximately 133 of the 195 cables required to support the electrical power subsystem-environmental control subsystem tests have been delivered to Downey.

The Test Support Requirements document (SID 62-975) for Clear Lake was reviewed at the test site; changes will be incorporated in the next revision to Exhibit G of the contract.

The site activation master plan submitted by Florida facility personnel is in final stages of revision. This plan includes activation task descriptions, documentation requirements, and site activation schedules and phasing plans.

The test site activation plan of action has been completed; this plan deals with modification of mock-ups and fabrication of systems test sets for Merritt Island Launch Area-Kennedy Space Center.

LOGISTICS ENGINEERING AND SUPPORT

The GSE Planning and Requirements List (SID 62-417) will be fully updated and republished during the next report period. This issue will reflect verification of all data relating to GSE planning and utilization.

The shipping plans for boilerplates 23 and 27 were completed and published.

DEVELOPMENT

SYSTEM DYNAMICS

Aerodynamics

Studies show that the simultaneous jettison of the apex cover and the launch escape tower with the boost protective cover attached, during an abort above 30,000 feet altitude, will probably result in damage to the parachutes and/or escape hatch caused by contact with the apex cover. A number of possible methods have been proposed to eliminate this hazard. One method provides for jettison of the apex cover 0.4 seconds after the ignition of the tower jettison motor and the firing of the separation bolts; other methods are being studied to sequence the firing of the jettison motor, the separation bolts, and the heat shield thrusters.

A summary of preflight analyses of the boost, abort, and recovery phases of the boilerplate 23 mission were made to NASA. The summary included the following recommendations:

1. The abort signal should be based on a real-time display of Mach number versus dynamic pressure in order to minimize test point dispersions. Two other methods (elapsed time from lift-off and a real-time display of Little Joe II Algol chamber pressures) are considered to be less reliable.

2. A three-degree thrust vector alignment of the launch escape subsystem (LES) should be adopted, and 510 pounds of ballast should be placed in the LES nose to provide the launch escape vehicle with maximum angle-of-attack excursions prior to canard deployment, consistent with no tumbling and retaining pad abort capability.

3. Little Joe II thrust termination will not be required for launch escape vehicle separation.

Dynamic stability tests were completed in the trisonic wind tunnel at NAA, Los Angeles, using the 0.059-scale launch escape vehicle model with and without canards and the command module model by itself. Aerodynamic damping characteristics were obtained at subsonic Mach numbers through a 360 degree angle-of-attack range. Similar data will be obtained at the Lewis Research Center in the low supersonic Mach number range during the latter half of September.

Earth Landing Subsystem (ELS)

Preparations for the water primary impact drop test of boilerplate 28 are proceeding satisfactorily. All work, including side wall modification, instrumentation installation, functional tests of attenuation struts, ballast installation, and weight and center of gravity checks will be completed in time to support the October 29 scheduled test date. The first impact drop test will be performed to demonstrate the structural integrity of the command module heat shield and aft bulkhead.

Parachute drop tests 67 and 68 using cylindrical bomb test vehicles were successfully performed at El Centro during this report period.

Drop test 67 was conducted to obtain total loads, reefed blanketing, and rate-of-descent data for a cluster of three parachutes. The data will be used in computer simulations to determine future drop conditions. The three main parachutes had 68 gores and a 75 percent open fifth ring. One pilot parachute separated at main parachute line stretch, but reefed load sharing was good. One reefing line cutter failed to operate, but this did not affect inflation.

Drop test 68 employed two drogue parachutes with 8-second, 41 percent active midgore reefing and 64 percent permanent midgore reefing. The test had a twofold purpose: (1) to determine the dual drogue drag area and reefing ratio effectiveness and (2) to obtain the rate of descent with the main parachutes having a 75 percent open fifth ring and 68 gores.

MISSION DESIGN

A study was completed to determine the prevailing lighting conditions during the transposition and docking maneuver for the period from January 1968 through June 1971. The parameters considered were launch window for north and south translunar injection, launch azimuth of 72 to 108 degrees, and elapsed time of 15 to 30 minutes from translunar injection to the start of the half-hour transposition and docking maneuver. The number of days per month[1] in which part or all of the maneuver might occur in darkness varied from none to eight, depending upon the year, month, launch window, azimuth, and elapsed time from translunar injection to the maneuver.

The adoption, however, of certain rules[2] for the lunar stay assures that the entire transposition and docking maneuver will occur in sunlight on any day of the period studied. These ground rules require that the sun's

[1]Using the nodical month that begins when the moon intersects the earth's equatorial plane

[2]Contained in the report of the trajectory analysis subpanel of the MSC mission planning panel

[redacted]

elevation be 15 to 45 degrees above the lunar horizon, that the subsolar point be east of the lunar landing site, and that the landing site lie within ±45 degrees selenographic[1] longitude.

The study concluded that supplemental lighting will not be required for the transposition and docking maneuver for the lunar exploration missions now proposed.

Permissible error in the alignment of Block II spacecraft during the stabilization and control subsystem (SCS) ΔV mode preparatory to service module engine firings was studied for transearth injection and midcourse correction. Preliminary results show that this error should not exceed one degree root mean square (RMS) in order to comply with the ΔV fuel allocation for midcourse correction and the crew safety requirement of a maximum entry corridor width of 20 nautical miles (NM). The error budget necessary to achieve this total pointing error of 1 degree RMS is shown in Table 1.

Table 1. Subsystem Error Allocation for Total Pointing Error of 1 Degree RMS

Error Source	RMS Magnitude, 1 Sigma (Degrees of Arc)
Scanning telescope	0.067
Attitude deadband	0.167
Astronaut error using hand controller	0.200
Body-mounted attitude gyro (BMAG)	0.340
Attitude indicator	0.107
Spacecraft thrust line computation uncertainty	0.100
Thrust vector control	0.584
Navigation base alignment	0.333
BMAG mounting alignment	0.100
Structural deformation	0.573
Root sum square (RSS)	Total 1.000

The values for the last three items listed have not been firmly established and may be reduced to offset unforeseeable minor increases in the first seven items.

[1] Referenced to the lunar prime meridian

[redacted]

[redacted]

The lift-to-drag ratio (L/D) design requirements were established for the Block II command module. Factors considered were entry performance criteria, present configuration, design, design tolerances, and contingencies. Table 2 summarizes the results of these studies.

Table 2. Block II Lift-to-Drag Ratio Design Summary

Considerations	L/D
Current Block II design Unballasted Umbilical relocated 80 pounds scientific equipment Three-man crew	0.38
Minimum entry L/D requirement 1500 to 2500 NM range	0.30
Design deviations in L/D Aerodynamic ±0.02 Center of gravity -0.04	-0.02 min. -0.06 max.
Final L/D design control limits	0.32 to 0.36
Design uncertainties in L/D (RSS) Aerodynamic +0.00692 Center of gravity ±0.0063 (Converted from ±0.1 inch)	±0.01
Expected entry L/D limits	0.31 to 0.37
Variations due to contingencies Loss of 60 pounds scientific equipment Loss of 2 crewmen (+0.04) plus 60 pounds scientific equipment	 -0.01 +0.03
Entry L/D design limits	0.30 to 0.40
Nominal design L/D	0.34

The L/D design limits will be used in defining Block II subsystem designs and design constraints. These limits were determined for an entry interface at 400,000 feet altitude, but do not account for trim aerodynamic variations during the entry flight phase; these variations are reflected in corridor requirements and/or ranging capability. Preliminary estimates of the required operational corridors (total guidance and navigation maximum deviations) as related to L/D are shown in Figure 2; they are based upon a required entry ranging of 1500 to 2500 nautical miles.

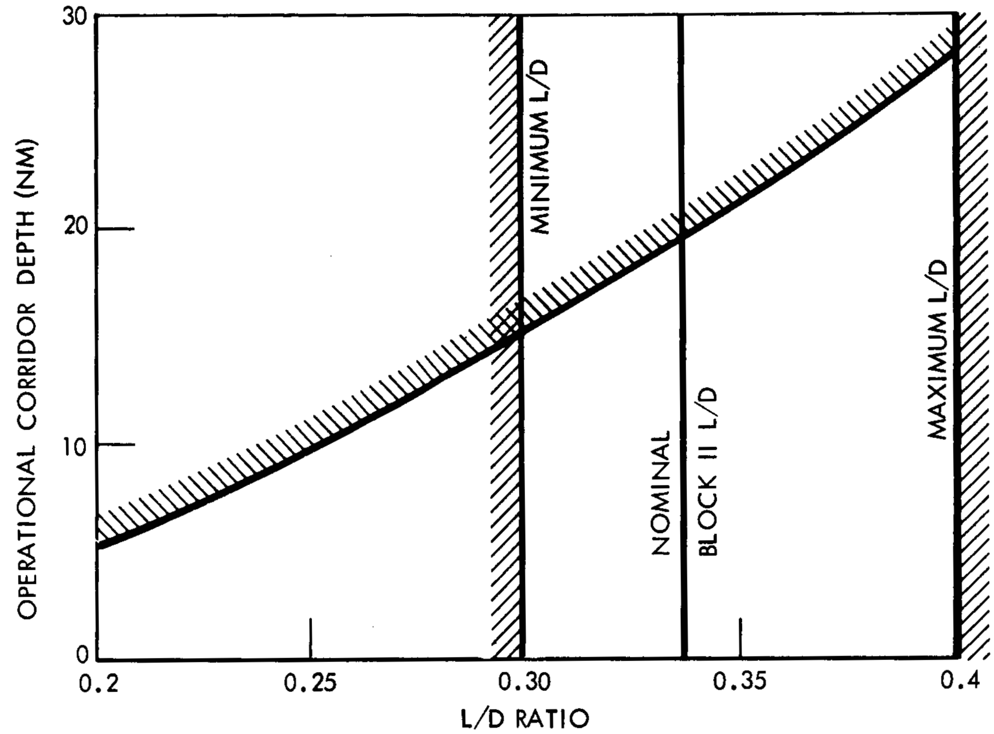

Figure 2. Block II Lift-to-Drag Ratio Design Envelope for Ranging Limits of 1500 to 2500 Nautical Miles

CREW SYSTEMS

During August, tests were conducted at Wright-Patterson AFB under zero-g conditions with subjects wearing pressurized Gemini space suits during the tests.

Crew couch ingress and restraint system attachment were successfully accomplished. A portion of the sextant alignment was successfully performed with the subject wearing S&ID-Velcro sandals to give body stability. Crew transfers through a Block II command module tunnel (29-inch diameter) were successfully accomplished. In one test, the subject made the transfer with the portable life-support subsystem (PLSS) strapped on his back, and on another run the subject carried the PLSS in his hands. Transfer was also accomplished with an 81-inch long umbilical hose attached to the subject's suit.

As a result of these tests, certain modifications were made to improve the crew lap belt. Also, the problem of rotating the couch seat to the earth landing position without readjusting the restraint harness was resolved.

Proposals for the design and manufacture of the flight kit assembly were received from Hughes Aircraft and National Cash Register, and are being evaluated. Minor revisions in the procurement specifications will be required to reflect additional information.

The entry 2 simulation study was completed August 21; the results of the following runs for the various entry modes are being evaluated:

1. A total of 216 runs were made to investigate the high-q dynamic stability phase: 70 of these were for training, 32 automatic runs were made as a baseline, and 114 were production runs.

2. A total of 241 runs were made in the manual guidance and navigation (G&N) phase: 102 of these were training runs and 139 were production runs.

3. A total of 126 runs were made in the automatic G&N phase: 95 of these were production runs with various simulated failures of the SCS, G&N, and entry monitor subsystem (EMS) inserted; 19 manual G&N runs were made to evaluate the resensitization of rate and error indications; and 12 runs were made to study different discrete rate variations.

In addition to runs made in these three entry modes, 11 runs were made to evaluate the effect of pressure suits on the subject's ability to perform tasks. Five runs were made with the suit pressurized, and six runs with the suit vented.

STRUCTURAL DYNAMICS

Model test results demonstrated that a three-bag flotation system, with one bag each on the +Y, -Y, and +Z axes, and flooding of the aft compartment are recommended for maintaining a single-point static flotation attitude for both Block I and Block II vehicles. Any two bags deployed in sequence are generally sufficient with the third to provide redundant capability. However, a two-bag operational mode employing the +Z axis bag requires that this bag be firmly retained on the +Z axis for reliability of operation.

Model tests to evaluate command module response to various random sea states will begin at Stevens Institute of Technology around November 1. Start date is dependent on a firm definition of sea-state criteria and modifications of the Stevens wave-maker to duplicate these criteria.

S&ID will assist Langley Field in reducing and correlating pressure and acceleration data obtained during impact tests using a fourth-scale model command module. This will permit S&ID to analyze and incorporate the test results into the test plan for boilerplate 28. Design of a tenth-scale model for in-house testing was completed. This design incorporates balsa wood damping on the aft heat shield to minimize structural ringing problems previously encountered. Fabrication of the model is scheduled to be completed and tests initiated by the first week of December.

An analytical study was completed to determine the maximum loads on the command module transfer tunnel wall during docking. The maximum predicted load will occur at the drogue attach point on the tunnel wall and will consist of 3800 pounds in bearing and 1200 pounds in shear. This load will occur under conditions of limit closing velocities, and with vehicle orientation so that the probe latches just before side-arm impact. These data were transmitted to Grumman.

STRUCTURES

Selection of a satisfactory conformal coating for moisture sealing of command module electrical-electronic equipment was made. The sealant is a polyurethane manufactured by Products Research Company.

Evaluation of meteoroid impact test data obtained at the Defense Research Laboratory of General Motors Corporation shows that Summer's penetration equation is very conservative. Actual penetration proved to be approximately two-thirds as deep in quasi-infinite targets as predicted by the equation.

An analysis of the dual drogue attach and disconnect fitting was completed. Several alloys are being considered for use in the disconnect blade including 4340 steel, 6Al4V titanium, and Inconel 718.

Command module-lunar excursion module O-ring seals were selected for the docking interface. These rings are compatible with the anticipated docking force and the required operating temperature of -150 F. A hollow O-ring for the initial seal and a solid O-ring for the final seal, both made from Dow Corning silicone rubber DC-6526, were selected.

A bearing lubricated by dry film was cycled 39,595 times under load in a 7.0×10^{-8} Torr vacuum to simulate space conditions. The kinetic coefficient of friction varied from 0.012 to 0.018—comparable to the maximum values for oil-lubricated antifriction bearings.

Initiator lot acceptance and qualification test procedures were submitted by both Hi-Shear and Space Ordnance Systems. The lot acceptance methods were acceptable, and qualification test plans are under study.

Steady-state leakage tests of the crew hatch window were completed at ambient temperature, 125 F, and 0 F. Leakage rates were 10 percent of allowable rates. A leakage test for 336 hours at 0 F is under way.

Bid proposals for the service module and lunar excursion module propellant dispersal subsystem (PDS) were received and are being evaluated. A preliminary layout for the PDS cartridges is in process. A design review of the PDS by NASA-MSC is tentatively planned for early October at S&ID, Downey.

GUIDANCE AND CONTROL

Honeywell is modifying the stabilization and control subsystem to meet the new humidity requirements. Electronic card assemblies will be conformal coated, switches and other equipment will be moisture sealed, and connectors will be modified as required. The change will be effective on spacecraft 008, 012, 014, 015, 017, and 020.

At an S&ID-NASA meeting August 26, a decision was made to build two of the optical alignment supports required for guidance and navigation checkout and/or the inertial measurement unit installation for use at S&ID-Downey. The design can be modified to permit use with the LES tower when the spacecraft is stacked.

Details of the spacecraft 011 mission programmer were defined. The programmer subsystem interfaces, procurement specifications, and specification control documents were released. Autonetics was authorized to proceed with the design and manufacture of the programmer.

The entry 2 simulation study, including an evaluation of entry subsystems for both manned and unmanned missions, was completed August 21. The major conclusions are as follows:

1. The flight control subsystem for the unmanned spacecraft 009 mission is acceptable.

[redacted]

2. Entry ranging with present SCS gains is possible only with dual reaction control subsystem for lunar return missions.

3. The manual G&N steering concept is acceptable.

4. Manual damping of wind gusts during the terminal phase is marginal.

A study was made of six possible methods of providing electronic redundancy in the SCS for the thrust vector control (TVC) function. The method recommended by S&ID and accepted by NASA is the rate command manual TVC; the change will be incorporated in spacecraft 012 and subsequent Block I vehicles.

TELECOMMUNICATIONS

Modification of the spacecraft console of the Apollo telecommunications engineering evaluation (ATEE) unit was completed. A partial checkout of the subsystems was made. The S-band subsystem—including the audio center, the premodulation processor, and the S-band power amplifier and transponder—was checked out and is in operation. The PCM checkout will be completed upon receipt of an engineering model of the signal conditioning equipment scheduled for delivery about November 1. NASA's request that the ATEE spacecraft console be shipped to MSC requires that S&ID build another unit for use at S&ID, Downey.

All boilerplate 14 communications equipment was received except the flight qualification recorder. The recorder will be delivered in time to meet the mid-January need date.

System tests are complete on the S-band and central timing bench maintenance equipment (BME). System tests are in progress on the C-band and television BME. The up-data link BME unit is scheduled for delivery by September 8.

Plans of action were prepared for the independent operation of the VHF and HF antennas. The VHF antenna design layout was presented at the spacecraft 009 design engineering inspection, and the design configuration consisting of two Gemini-type stub antennas was established. Present plans are to use an extendible antenna for HF recovery communications.

As a result of an S&ID-NASA measurement coordination meeting held August 27 and 28, the spacecraft 012 measurement list will be revised to an optimum configuration for a block R & D concept. The proposed change will apply to spacecraft 012, 014, and 015. Spacecraft 017 and 020 will have the same measurement list except for heat shield instrumentation.

[redacted]

ENVIRONMENT CONTROL

The environmental control subsystem (ECS) design is being modified to assure that possible moisture conditions in the crew compartment would not affect ECS operation. Relative humidity conditions considered varied from 0 to 100 percent, including condensation as water or frost.

An analysis of the water requirements of a three-man suited crew was completed for a 14-day lunar mission. Waste water will be produced at the rate of 7.7 pounds per man per day, and potable water will be required at the rate of 9.6 pounds per man per day.

A study shows that the high-gain antenna's earth sensor lens, if made of pure silicon, would function satisfactorily under radiation levels expected during a lunar mission. Pure silicon irradiated with 10^8 ergs per gram-centimeter shows no effect when used as a lens to transmit infrared in wavelengths of 1 to 14 microns. Coated silicon lenses, however, show degradation under similar levels of irradiation.

The maximum prelaunch temperature of the Apollo launch escape vehicle was computed for two different candidate coatings. With an ordinary white lacquer or enamel paint having a solar absorptivity-to-emissivity ratio of 0.50, a temperature of 150 F results. With a white organic coating designed to control temperature, a temperature of 125 F can be expected. The study was based on the use of KSC or WSMR as launch sites. The data obtained are being evaluated.

Transient temperature gradients of the electrical power subsystem (EPS) panels during boost were computed. Based on an initial temperature of 170 F and inoperative radiator conditions—more severe than operative conditions—the maximum temperatures to be reached by the radiator panels and the coolant fluid will be, respectively, 264 F and 259 F. No major design problems result.

ELECTRICAL POWER

A single fuel cell power plant was tested successfully at S&ID under vacuum conditions. Two fuel cell power plants connected in parallel are scheduled to be tested under vacuum conditions during the next report period. The parallel test will be run following the incorporation of a recently developed two-position delta pressure differential regulator. This regulator will permit the use of a low-pressure differential between the nitrogen blanket and the reactant subsystems during start-up, and a higher differential during operation.

[redacted]

All cryogenic gas storage subsystem (CGSS) hardware has been delivered for boilerplate 14 and spacecraft 001 except the spacecraft 001 hydrogen and oxygen tanks, which will be installed out of station.

The third oxygen Inconel vessel was successfully burst tested at Beech Aircraft. This vessel was hydrostatically ruptured at 1873 psig ambient temperature. (Predicted burst pressure was 1819 psig.)

Using new National Bureau of Standards data, an analysis was completed for oxygen vessel pressure decay resulting from maximum oxygen demand. The analysis was based upon continuous operation of the vessel heaters and fans and normal heat leakage. It was determined that, 36 hours after CGSS activation, a flow rate of 5.2 pounds per hour per vessel can be sustained indefinitely without incurring pressure decay. The pressurization of the lunar excursion module, however, is scheduled to begin 12 hours after CGSS activation at the computed flow rate of 5.2 pounds per hour for 30 minutes and will result in a pressure decay of 168 psi. This decay is not great enough to cause the formation of liquid in the storage vessel, nor will it reduce flow capability. When the flow rate is reduced to normal, the vessel pressure will rapidly return to the 900-psia operating level. The study indicates that the present oxygen vessel heaters and fans have adequate capacity for the planned flow rates of Block I and Block II vehicles.

The first undervoltage sensing unit was completed. A minor variation from the insulation resistance specification is being investigated.

Westinghouse delivered a static inverter for use on boilerplate 14 prior to the receipt of prototype units specifically designed for this test vehicle.

The six pyrotechnic batteries to be used for qualification testing are in production at Electric Storage Battery. Qualification tests are scheduled to begin in early November.

The Electrosolids three-phase inverter required to power the ECS glycol pump for boilerplate 15 was successfully vibration tested. (Temperature and altitude tests had been completed previously.)

The status of the Eagle-Picher entry battery qualification tests is shown in Table 3.

[redacted]

Table 3. Entry Battery Qualification Test Status

Number of Test Batteries	Phase of Qualification Test	Status
2	Humidity test	Started September 8
1	Dynamic environment including shock, acceleration, and environment	Completed
2	Last discharge cycle of life test	Being charged prior to test
1	Charged stand test	Three weeks to complete

The packaging specification for Block II electronic equipment is being prepared and should be completed by mid-October. The specification will include environmental, vibration, humidity, and temperature requirements in addition to detailed design requirements describing the configuration, over-all size, mounting provisions, interface and GSE connector locations, chassis and cover, sealing, and finish requirements. Materials for sealing and potting of wire, printed circuit boards, and other components will also be specified.

PROPULSION

Service Propulsion Subsystem (SPS)

26 engine firings were accomplished during this report period. Gimbal operation with the mass simulator installed was satisfactory. The dynamic stability program continued with 15 injector firings. Table 4 lists all firings conducted during this report period.

A subsystem design providing for nitrogen purging of test fixture F-2 propellant feed lines and engine injector, following shutdown, was released. Installation is to be accomplished before the first engine firing on this test fixture at WSMR. Installation of test fixture F-3 in the test cell at Arnold Engineering Development Center (AEDC) was completed in preparation for the Phase II altitude SPS engine test program.

The propellant retention reservoirs for spacecraft 001 were fabricated, leak-checked, and cleaned, and are ready for vehicle installation.

C[redacted]

Table 4. Apollo SPS Engine Test Program

Serial No.	Pattern Type	Type of Evaluation	Ablative Chamber		Steel Chamber		Engine		Remarks
			No. of Firings	Time (sec)	No. of Firings	Time (sec)	No. of Firings	Time (sec)	
AFF-72	POUL-31-10	Acceptance tests	1		5	28.0			Rejected, face leakage
0010 (5-4-4)	POUL-41-36	C*			3	16.0			Two pressure spikes during last firing
0009 (5-4-2)	POUL-41-56	C*			2	10.5			Satisfactory
		Pulse			1	5.0			Did not recover from 156.9 grain pulse
0003 (5-4-2)	POUL-31-52	C*			4	7.54			Extremely rough, three firings terminated by CSM unit
0013 (5-4-4)	POUL-41-26	Checkout	1	91					Five minor streaks at baffle
		Mission duty cycle	4	433					Hole burned in baffle
Engine assembly 0009	AFF-78 POUL-31-10	Gimbal					26	751	Gimbal operation accomplished with mass simulator. Various inputs

C* = Characteristic exhaust velocity

[redacted]

Reaction Control Subsystem (RCS)

The Dynatube special end fittings for the command and service modules were successfully qualification tested, and off-limits testing was begun. 100 prequalification parts are now being acceptance tested.

Rocketdyne completed a 14-day temperature cycling test on a prequalification command module RCS engine in vacuum conditions. Physical examination of the engine indicated no significant effect. The engine is now scheduled for a hot-firing test simulating the entry duty cycle.

Functional and leakage tests using the Phase II breadboard of the command module RCS were completed. This concludes all checkouts prior to actual hot firing; a calibration hot firing is scheduled for the latter half of September.

During the prefill operation for the third test employing the Phase II breadboard of the service module RCS, the oxidizer tank collapsed. A valve in the helium vent line was allowed to remain closed, resulting in a lack of pressure on the helium side of the bladder while a vacuum was applied to the propellant side. The tank was pressurized to 100 psig to return it to its original size. Subsequently, the tank was pressurized to proof pressure (331 psig) without visible damage.

Launch Escape Subsystem (LES)

12 LES motors were static tested during August to complete the qualification test program. Data reduction and analysis are in process. Performance predictions were submitted for the LES motors of boilerplates 15 and 23, and the results indicate that they should perform satisfactorily. 21 pitch control motors were static tested to complete the qualification test program.

The first 2 of the scheduled 20 qualification tests of the tower jettison motor were conducted during this report period. Both units performed within specification limits. The second qualification motor was fired successfully with a single hotwire igniter cartridge.

Borescope grain inspection of the LES motor assigned to boilerplate 23 took place at WSMR on August 31 and September 1 and 2. Grain condition was excellent. The motor was reassembled and pressure tested without incident.

The spare tower jettison motor intended for boilerplate 12 was retrofitted with new nozzles and igniter assembly of the final design configuration and was pressure tested successfully for use as a spare for boilerplate 23.

[redacted]

Propulsion Analysis

Drop tower tests confirmed, in part, earlier predictions of SPS propellant motions. High-amplitude motions and dispersion of bubbles in the liquid were noted. Test results, now being used to refine propellant motion models, will be used as input for a probability analysis of propellant settling requirements. Further drop tower testing is planned.

A draft of the final report on passive thermal control engine design studies was received from Marquardt on September 4. All the testing and analyses requested were completed, with the exception of the thermal resistances of various candidate chamber-to-injector head seals.

The effect of low-energy, zero-g propellant slosh on the special attitude hold requirement for Block II vehicles was evaluated. On the basis of the recently formulated propellant slosh model, up to 25 corrections per second may be required to maintain the 0.002-degree per second maximum drift rate about any of the vehicle axes. The slosh disturbance will diminish to less than one-third its initial value in 50 minutes, but will be reinitiated by attitude changes or SPS firing. A multiple-screen retention and baffle configuration in the SPS tanks would reduce the effect and duration of zero-g or low-g slosh to one-tenth or less of the above values.

GROUND SUPPORT EQUIPMENT

Acceptance Checkout Equipment (ACE-SC)

The first ACE-SC control room (located at S&ID, Downey) completed the NASA 72-hour acceptance test and is now considered operational. Steps are being taken to assure that the ACE-SC equipment will be ready for boilerplate 14 installation on November 13. Four tests are being conducted as follows:

1. Breadboard uplink and downlink subsystems to control room interface verification test

2. Uplink (digital test command subsystem) integration test

3. Downlink (digital test measurement subsystem) integration test

4. ACE-SC to GSE interface verification test

The breadboard interface test was completed; the uplink tests are 40 percent complete and are on schedule; and preparation for the downlink test is being expedited to place this test on schedule. Tests on individual hardware units indicate that no major problems will be found during ACE-SC to GSE interface tests.

Special Test Units (STU)

The test conductor console was shipped to the propulsion system development facility (PSDF) in mid-August.

Spacecraft Instrumentation Test Equipment-Bench Maintenance Equipment (SITE-BME)

Functional verification of the telemetry ground station was completed successfully, and a modification kit was installed.

Fuel cell power plant BME was acceptance tested at Pratt & Whitney Aircraft; delivery should be on schedule.

One engine decontamination unit was successfully tested and shipped to PSDF. A second unit is scheduled for delivery to PSDF in late September. These units transfer and filter facility-supplied liquids requiring decontamination. They also filter, heat, and regulate the pressure of facility-supplied gaseous nitrogen.

GSE Cable Subsystems

Cable design and drafting of SCS cables for SITE-BME is complete. Design of cables for the communication and instrumentation portion of the ACE-SC carry-on J-box was completed. These cables will interface between SITE and ACE-SC cables.

SIMULATION AND TRAINERS

Five Apollo system trainers are scheduled for delivery to NASA: four in November and one in January. Their design has been completed, all components have been ordered, and manufacture is now 43 percent complete. These trainers are to provide experience for flight crews and other operational personnel before they use advanced training equipment.

Each trainer consists of a mechanized lighted-line representation of one or more spacecraft subsystems, associated subsystem controls, a special signal panel, and a malfunction panel. Each trainer is a complete unit and operates independently of other trainer units. Four subsystems (propulsion, SCS, EPS, and ECS) are each represented by a separate trainer. The fifth trainer shows the sequential flow of the LES, the earth landing subsystem (ELS), the emergency detection subsystem (EDS), and the crew safety subsystem (CSS). Each trainer gives a pictorial representation of scheduled subsystem events; required alternate actions are shown for inserted malfunctions.

VEHICLE TESTING

The revised test plan for boilerplate 14 was completed and has been reviewed by NASA. The command module, service module, and adapter have been stacked at S&ID, Downey, and the vehicle is being readied for EPS and ECS subsystem tests scheduled to start immediately. Integrated subsystem tests are to be performed beginning November 27 with ACE-SC and associated GSE.

Boilerplate 28 fabrication was completed; the vehicle is being prepared for impact testing. Boilerplate 29 design was 100 percent released; detail fabrication is in progress. Spacecraft 005 has been deleted from the test program; the disposition of fabricated hardware is under study.

During this report period, the SPS engine was installed in the F-2 test stand at WSMR. Checkout and validation of GSE and instrumentation, incorporation of subsystem modification, and preparation of facility equipment are in progress prior to the first engine firing scheduled for late September.

RELIABILITY

The reliability flight readiness report for boilerplate 15 was completed. The report includes logic diagrams, failure mode and single-point failure analyses, mission and environmental data, minimum airworthiness status, operating time data, and an analysis of applicable nonconformance reports.

Three boilerplate 15 components are "open" reliability items: a newly designed tower sequencer motor switch that failed during mission airworthiness tests, a Government-furnished equipment (GFE) thermocouple, and a GFE temperature zone box. Because of the failure of the boilerplate 15 motor switch and other malfunctions associated with high contact resistance, a switch of the same configuration as that used on boilerplates 12 and 13 will be installed. Testing of the GFE thermocouple is in progress; testing of the GFE temperature zone box was completed, and the final report is being prepared for study.

The Block II SCS was assigned a primary backup function to G&N according to the Block II integrated guidance and control (G&C) concept. Revised reliability requirements provided for the new concept include the following:

1. Failure rate requirements for SCS components in lieu of an over-all SCS failure rate

2. New SCS humidity environmental requirements

A Block II reliability analysis was completed for a six-tank CGSS configuration consisting of three oxygen and three hydrogen tank subsystems. The six-tank configuration would increase mission success reliability by two orders of magnitude compared to the present four-tank CGSS. Further, the proposed six-tank design would extend mission capability by allowing the mission to continue after a single-tank subsystem failure, because each tank would hold sufficient fuel for one-half mission.

INTEGRATION

Boilerplate 23 integrated subsystems testing was conducted at S&ID, Downey, on August 28. A report of the tests was transmitted to NASA. The tests verified the integrity and compatibility of the vehicle's mechanical, electrical, and instrumentation subsystems during operations simulating the boilerplate 23 mission. Only two problems remain that require corrective action: (1) modification of the GSE Little Joe II simulator to make it possible to check the lamps in any circuit whenever desired, and (2) rework of the NASA-furnished GSE onboard tape recorder which malfunctioned (possibly because of a defective clutch).

A mock-up is being made to study mechanical interfaces of the lunar excursion module, adapter, and associated GSE. The lower portion of the adapter and base stand were completed, and the lunar excursion module mock-up was installed in this portion; the upper portion is 50 percent complete.

During the report period, a new outline was developed for the individual vehicle test plans for flight spacecraft. The revised plan will contain information required to prepare the flight vehicle for launch, flight, and recovery operations. The plan will continue to furnish information for use in preparing the mission directive. More definitive criteria, including data requirements and analyses, will be developed as a standard for measuring the accomplishment of flight objectives. A section is being added to define prelaunch requirements.

[redacted]

The Block I vehicle flow diagram and associated preflight test and checkout sequence diagrams were developed and will be presented to NASA-MSC at the next checkout panel meeting. A preliminary Block II vehicle ground operations specification was completed and is being reviewed.

Timelines of operational sequences and critical design requirements are being developed for the Phase II report of the Apollo Mission Planning Task Force. The effort is being coordinated with Grumman.

Block I and II control weights were established as shown in Table 5.

Table 5. Block I and Block II Control Weights

Module	Weight (lb)
Launch escape subsystem	8,200
Command module	11,000
Service module	10,200
Adapter	3,800

A preliminary list of malfunction priority ranking was compiled for the 800 subsystem output functions used in logic diagrams for the earth orbital and lunar landing missions in support of Apollo mission simulator work. 12 abort diagrams for the lunar landing mission are being released.

[redacted]

OPERATIONS

DOWNEY

Boilerplate 23

During the report period, preparatory testing and mission readiness testing were accomplished on boilerplate 23 before shipment to WSMR. Individual systems checkouts were completed, and the electromagnetic interference test was accomplished. On August 28, the integrated systems test was performed successfully. All tests were reviewed at the post-test review meeting on August 29 and accepted by NASA, engineering, and quality control. Accomplishment of the integrated systems test ended mission readiness testing.

The launch escape tower was demated, and action was begun to fit the soft boost protective cover to the command module. Rework of the soft boost cover was required. The command module and launch escape tower were remated for inspection of the refitted soft boost protective cover. The inspection, performed on September 11, resulted in minor rework of the soft cover, but preparations were continued for shipment of boilerplate 23 to WSMR.

Fit checks of the command module and service module cameras were completed. The service module was painted and then shipped by aircraft, arriving at WSMR at the end of the report period. The command module and launch escape tower will be shipped to WSMR during the next report period.

Boilerplate 14

Integrated checkouts of the ground support equipment for the environmental control subsystem (ECS) and the electrical power subsystem (EPS) were completed on August 31. The adapter was installed on its base at Station 101 in building 290. The command module and the service module were stacked on the adapter on September 4. Continuity checks of the command module and service module wire harness were begun in preparation for EPS checkout.

The load bank required for EPS checkout was received, and its validation checkout was accomplished. Modification of the C-band beacon transponder was completed. Validation checkout of the ECS special test unit was accomplished.

The installation of crew systems wire harness and tubing for the waste water management system was completed.

During the next report period, the checkout of the ECS and the EPS will be completed. The ground support equipment will be reworked as required, hooked up, and checked out. Installation of the communications and instrumentation equipment, the stabilization and control subsystem, and the reaction control subsystem will be completed.

WHITE SANDS MISSILE RANGE (WSMR)

Propulsion System Development Facility (PSDF)

Preparatory activities were continued to obtain operational status for test fixture F-2. The test fixture rupture disc modification and the engine actuator check valve spool installation were completed satisfactorily. The flow integrators and associated wiring were installed. Checkout and calibration of the vibration safety cutoff system and checkout of the control and response of the test fixture from the interim fire control console were accomplished on August 25.

Validation of the fuel ready storage unit was accomplished on August 25. Validation and calibration of the oxidizer ready storage unit and the decontamination unit were completed on August 27. Installation of the sight gauges on the fuel and oxidizer tanks of the test fixture was completed on August 28. Validation of the fuel and oxidizer toxic vapor disposal units was completed on September 1.

All test fixture pressure and temperature transducers were calibrated, and installation of the transducers and wiring harness was completed. The engineering and implementation of the post-fire purge modification to the test fixture was started on September 8. The load cell was calibrated on September 9. The leak check was performed satisfactorily. The engine interface leak check was completed, and the F-2 flowmeters were installed on September 10.

On September 15, circulation of fuel from the fuel ready storage unit through the fluid distribution system to the three-way valve and back to the fuel ready storage unit was accomplished.

During the next report period, the first 10-second hot-firing shakedown test will be conducted. The second 10-second hot-firing test, for steady-state and shakedown repeatability, will be conducted. A hot firing of 10 seconds, followed by a 5-minute shutdown and then a 30-second hot firing, will follow, to demonstrate restart and steady-state operation. Finally, a hot firing of 30 seconds will be conducted, followed by a 5-minute shutdown, then a 180-second firing to demonstrate restart and extended steady-state operation.

Mission Abort

The modified launch escape motor hold-down fixture was mated to the 300,000-pound thrust stand for the launch escape motor grain inspection which was completed on September 1. The skirt was installed on September 2, and the assembly was transported to the vertical assembly building later the same day.

Setup of the launch escape subsystem (LES) buildup fixture and setup and leveling of the LES weight and balance fixture were completed.

The receiving inspection, including pressure checks, of the pitch control motor and the launch escape tower jettison motor was completed on September 10.

The boilerplate 23 service module was received on September 15 and transported to launch complex 36.

During the next report period, command module receiving inspection will be accomplished, the parachutes will be installed, and the horizontal weight and balance will be completed. The launch escape subsystem will be assembled, and weight and balance will be accomplished. The service module receiving inspection will be accomplished. The GSE receiving inspection, installation, and GSE-facility checkout will be completed.

FLORIDA FACILITY

Boilerplate 15

Field operations were continued to ensure the readiness of boilerplate 15 for flight. The spacecraft-launch vehicle over-all test 1 (with umbilical plugs in) was conducted on August 19. This test demonstrated and verified the compatibility of the spacecraft and launch vehicle systems during simulated flight, verified that no transients exist in the pyrotechnic circuitry during a simulated mission, and monitored sequencer command signals of the booster interface. Radio frequency interference between the spacecraft telemetry link B and the launch vehicle telemetry was encountered.

All spacecraft telemetry links were found to be satisfactory, but activation of the launch vehicle telemetry link in the S-I stage superimposed a strong signal on the spacecraft link B. The spacecraft test team supported the launch vehicle test team in the resolution of this problem, and on August 24 a spacecraft-launch vehicle radio frequency interference test was satisfactorily completed. This test verified radio frequency compatibility between the spacecraft, the launch vehicle, and the range. During this test, however, the A circuits were found broken in the launch escape tower connector (explosive bolt igniter connector). The wire was repaired, and a continuity check of the circuits was conducted successfully on August 25.

The end of field operations, expected on September 15, was changed to September 17 by the additional requirement to accomplish the SA-7 spacecraft countdown demonstration before the actual spacecraft countdown.

The spacecraft-launch vehicle over-all test 2 (with test ordnance, umbilical plugs out, and the swing arm operating) was successfully completed on August 29. The test demonstrated and verified compatibility of the spacecraft and launch vehicle systems during a simulated mission.

The spacecraft-launch vehicle over-all test (launch vehicle simulated flight) was completed on September 3. The launch escape subsystem demonstrated its capability by blowing 0.75-ampere fuses, at each squib location, in less then 20 milliseconds after receipt of the jettison signal.

A crack was discovered in the body of one of the launch escape tower bolts while the initiator test fuses were being disconnected. The tower was removed, and all bolt bodies were sent to the laboratory. No further discrepancies were observed. New bolt bodies were laboratory tested before installation. The tower was remated to the command module later the same day.

The revalidation of all electrical connections between the command module and the launch escape subsystem was completed successfully before securing for hurricane Dora on September 8. An ultrasonic test was run on the four explosive bolts installed in the launch escape subsystem; no cracks were detected.

Approximately four work days were lost because of the two hurricanes (one and one-half days because of hurricane Cleo and two and one-half days because of hurricane Dora); however, three days were recovered. The end of boilerplate 15 field operations was extended one day to September 18 because of time lost due to the hurricanes.

Two aluminum plates were added, for structural rigidity, to the instrumented reaction control subsystem engine quad A on September 11. One plate was mounted on the +Y side, and the other plate was mounted on the -Y side of the engine quad. This installation was accomplished to ensure satisfactory performance during the boost phase of flight.

The SA-7 spacecraft countdown demonstration was accomplished satisfactorily on September 14 and 15. No major spacecraft problems were experienced. The spacecraft was then prepared for the final 2-day countdown expected to begin early on September 17, with T - O to occur at 1000 hours EST on September 18.

Boilerplate 16

Boilerplate 16 buildup and checkout operations will be resumed following boilerplate 15 flight. The command module-to-service module fit check is expected to be accomplished on October 12. Completion of the LES buildup is expected on October 14, followed by LES weight and balance determination on October 15. The end of boilerplate 16 field operations is currently expected to be December 15.

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FACILITIES

DOWNEY

Building 290

Erection of all boilerplate 14 workstands in building 290 is complete. These are the integrated workstand, cable arm tray, base support stand, and maintenance stand.

The contract for installation of the fluid distribution system was awarded during the report period. Completion is scheduled within three months.

The concrete pads have been poured, and plumbing is being installed for the gas storage and distribution system (building 290) to provide gaseous nitrogen and helium to all test stations.

Impact Test Facility, Pool Extension and Deepening

The construction contract was awarded during the report period. Completion is scheduled for October 24 and will support the test schedule of boilerplate 28.

Engineering and Support Rearrangements

The relocation and rearrangement of approximately 2100 personnel is complete. A summary of this operation will be compiled outlining the methods, coordination plan, and project control techniques utilized. This documentation will be retained in permanent files for reference in the event of future rearrangements of this scope.

APPENDIX

S&ID SCHEDULE OF APOLLO MEETINGS AND TRIPS

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S&ID Schedule of Apollo Meetings and Trips
August 16 to September 15, 1964

Subject	Location	Date	S&ID Representatives	Organization
Boilerplate 23 WSMR support	White Sands, New Mexico	August 16 to 18	Vipond	S&ID, NASA
Boilerplate 22 training program	Houston, Texas	August 16 to 19	Chaves, Miller	S&ID, NASA
G&N checkout work group	Cambridge, Massachusetts	August 14 to 21	Gresham, Olds	S&ID, MIT
ACE documentation	Houston, Texas	August 16 to 21	Garing	S&ID, NASA
Training session	Ann Arbor, Michigan	August 16 to 21	Tomooka	S&ID, Applied Dynamics
CDC 160G computer programming training	Minneapolis, Minnesota	August 16 to September 4	Togo	S&ID, Computer Data
Acceptance test direction	Santa Clara, California	August 17 to 18	Sztukowski	S&ID, Explosive Technology
Modification discussion	Cape Kennedy, Florida	August 17 to 19	D'Ausilio	S&ID, NASA
Checkout plans development	Cambridge, Massachusetts	August 17	Olds	S&ID, MIT
Building 290 design review	Houston, Texas	August 17	Lewis, Ray, Malysz	S&ID, NASA
Earth impact tests, study	Hampton, Virginia	August 17 to 19	Schmidt	S&ID, Langley Research
Block II design review, integrated G&C coordination	Minneapolis, Minnesota Houston, Texas	August 12 to 20	Knobbe, Walli, Levine, Witsmeer	S&ID, Honeywell, NASA
Schedule investigation and coordination	Cedar Rapids, Iowa	August 17 to 20	Hagelberg	S&ID, Collins
EMI scan review	Minneapolis, Minnesota	August 17 to 20	Antletz, Frankos	S&ID, Honeywell
Stable injectors, monitoring	Sacramento, California	August 17 to 21	Mower	S&ID, Aerojet
Command module and lunar excursion module meeting	Windsor Locks, Connecticut	August 17 to 23	Hornick, Pratt	S&ID, Hamilton Standard
Digital computer review	Framingham, Massachusetts	August 15 to 23	Kerr, McCarthy, Robertson	S&ID, Computer Control, Link, G. P. I.
Block I control redundancy problem	Houston, Texas	August 18 to 19	Geheber	S&ID, NASA
Refurbishment plan boilerplate 23A	Houston, Texas	August 18 to 19	Petrey	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
August 16 to September 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
MTS/LMS requirements	Houston, Texas	August 18 to 19	Bruggerman, Steisslinger, Wright	S&ID, NASA
Flight operations planning	Houston, Texas	August 18 to 20	Helms	S&ID, NASA
Mechanical integration panel	Huntsville, Alabama	August 18 to 20	Gardner	S&ID, NASA
Ordnance items, standardizing	Houston, Texas	August 18 to 20	Hitchens	S&ID, NASA
Subpanel meeting	Huntsville, Alabama	August 18 to 21	Tooley	S&ID, NASA
Fabrication problems, meeting	Tarrytown, New York	August 18 to September 4	McKellar, Bratfisch	S&ID, Simmonds
Development test program	Houston, Texas	August 19 to 20	Hartley	S&ID, NASA
Waste management system	Houston, Texas	August 19 to 21	DeWitt, Paulsen, Scott	S&ID, NASA
Little Joe II, discussion	San Diego, California	August 20	Lish	S&ID, General Dynamics
Material procurement design review	Sacramento, California	August 20	Caldwell, Colston	S&ID, Aerojet
Toxicological evaluation	Dayton, Ohio Bethpage, L. I. New York	August 20 to 26	Edgerley	S&ID, Aerospace Medical Labs, Grumman
Service propulsion system review	Tarrytown, New York	August 23 to 25	Field	S&ID, Simmonds
Technical management discussions	Buffalo, New York	August 23 to 26	Burge, Frankhouse	S&ID, Bell
Monthly coordination meeting	Minneapolis, Minnesota	August 23 to 26	Wallace	S&ID, Control Data
Zero-g flight test	Dayton, Ohio	August 23	Armstrong	S&ID, AF
Purchase order review	Tarrytown, New York	August 24 to 25	Rood, Tayne	S&ID, Simmonds
Technical progress monitoring	Sacramento, California	August 24 to 28	Mower	S&ID, Aerojet
Coordination meeting	East Hartford, Connecticut	August 24 to 28	Champaign, Garnett, Nash, Tayne, Wermuth	S&ID, Pratt & Whitney
Technical discussion	Bethpage, L. I. New York	August 24	Kolody	S&ID, Grumman

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S&ID Schedule of Apollo Meetings and Trips
August 16 to September 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Technical coordination	White Sands, New Mexico	August 24 to September 9	Thomas	S&ID, NASA
Prelaunch operations plan meeting	Bethpage, L. I., New York	August 24 to September 5	Gardner	S&ID, Grumman
Block II radiator discussion	Houston, Texas	August 25 to 26	Kinsler, Reithmaier, Jay	S&ID, NASA
Block I and Block II communication changes, review	Houston, Texas	August 25 to 27	Page, Tyner, McCabe, Bologna	S&ID, NASA
Block II command module crew integration systems meeting 1	Houston, Texas	August 25 to 27	Smith, Dziedziula, Bartholomew	S&ID, NASA
Digital costs comparison discussion	Houston, Texas	August 25 to 27	Siev	S&ID, NASA
Test data working group meeting	Milwaukee, Wisconsin	August 25 to 28	Wellens, Rutowski, Christy	S&ID, AC Spark Plug
Schedule investigation and coordination	Scottsdale, Arizona	August 30 to September 1	Hagelberg	S&ID, Motorola
Management review meeting	Rolling Meadows, Illinois	August 31 to September 2	Beeman	S&ID, Elgin
F-2 status and schedule review	White Sands, New Mexico	September 1 to 3	Field, Gallanes	S&ID, WSMR
Schedule positions, investigation and negotiation	Cedar Rapids, Iowa	September 1 to 4	Hagelberg	S&ID, Collins
Fuel cell schedule and costs, presentation	Houston, Texas	September 2 to 3	Nash, Wermuth	S&ID, NASA
Electronic unit packaging specification changes, discussion	Houston, Texas	September 2 to 3	Fleck	S&ID, NASA
1965 budget requirements, review	Minneapolis, Minnesota	September 2 to 8	Colaianni, Leffler, Axes	S&ID, Honeywell
Model and tunnel installation detail review	Mountain View, California	September 3 to 4	Monda	S&ID, Ames Research Laboratory
Boilerplate 15 flight readiness review	Cocoa Beach, Florida	September 3 to 10	Pearce, Harvey, Parker	S&ID, Florida facility
Task group meeting	Binghamton, New York	September 5 to 11	Kitakis	S&ID, General Precision
Document preparation review	Houston, Texas	September 7 to 9	Kennedy	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
August 16 to September 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Boilerplate 22 testing and checkout, witnessing	Houston, Texas	September 7 to 10	Fryxell, Miller	S&ID, NASA
Boilerplate 15 flight readiness review, participation	Cocoa Beach, Florida	September 7 to 10	Skene, Condit, Petrey, Stone, Spencer, Klas, Necker, Stephens, Nichols	S&ID, NASA
Technical problems, coordination and review	King of Prussia, Pennsylvania	September 8 to 9	Ross	S&ID, NASA
Engineering problems, discussion	Glen Head, New York	September 8 to 10	Latino	S&ID, Lundy
Engineering coordination meeting	Bethpage, L.I., New York	September 8 to 10	Gilson	S&ID, Grumman
Program review meeting	Sacramento, California	September 8 to 10	Field	S&ID, Aerojet
Monthly technical interchange meeting	Lowell, Massachusetts	September 8 to 11	Morant, Kinsler, Howard, Statham, Nelson, Nixon	S&ID, Avco-RAD
Subcontractor FY 65 tasks and cost negotiation	Boulder, Colorado	September 8 to 11	Bouman, Templeton, Frost	S&ID, Beech
Engineering coordination meeting	Janesville, Wisconsin	September 8 to 11	Wilson, Drott	S&ID, Gibbs
Engineering coordination meeting	Minneapolis, Minnesota	September 8 to 12	Cavanaugh	S&ID, Honeywell
Monthly checkout coordination meeting	Bethpage, L.I., New York	September 8 to 13	Harkins, Gilson, Morris	S&ID, Grumman
Proposal review	Las Cruces, New Mexico	September 8 to 11	Webb	S&ID, WSMR
Recovery antenna test review and discussion	Melville, New York	September 8 to 25	McCabe, Mercado Ferrer	S&ID, Airborne Instrument Laboratories
Apollo mission planning task force meeting	Houston, Texas	September 9 to 10	Vucelic	S&ID, NASA
Technical progress monitoring and evaluation	Sacramento, California	September 10 to 11	Mower	S&ID, Aerojet
Revised test schedule review	Sacramento, California	September 9 to 11	Cadwell, Colston	S&ID, Aerojet

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S&ID Schedule of Apollo Meetings and Trips
August 16 to September 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Contamination and cleanliness coordination meeting	Bethpage, L. I., New York	September 9 to 11	Kroffo	S&ID, Grumman
Follow-up procurement fact-finding meeting	Waltham, Massachusetts	September 9 to 12	Hardaway, Moen	S&ID, Space Science
Block change request and computer complex review	Binghamton, New York	September 5 to 16	Frimtzis, Flatto, Kitakis, Petak, Mattei, Wright, Bruhn	S&ID, General Precision
Building 32, 36, and 358, layout preparation discussion	Houston, Texas	September 13 to 19	Young	S&ID, NASA
Supplier facility survey	Buffalo, New York	September 13 to 19	Dykstra, Bettis, Ellis, Westfall	S&ID, Bell
GSE status and schedule requirements, coordination	Houston, Texas	September 14 to 25	Ellstrom	S&ID, NASA
Exhibit G contractual aspects, discussion	White Sands, New Mexico	September 15 to 17	Coulson	S&ID, WSMR

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